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(54) **SURGICAL FORCEPS**

(57) A surgical forceps including an end effector assembly has first and second jaw members. At least one of the first or second jaw members has a jaw frame defining a channel therein, an insulative member disposed within the channel of the jaw frame, and an electrically-conductive plate having a tissue contacting surface and at least one folded side portion. The insulative member includes a top portion having a tissue facing surface.

The tissue contacting surface of the electrically-conductive plate is disposed on the tissue facing surface of the insulative member. The at least one folded side portion of the electrically-conductive plate is folded over the top portion of the insulative member such that the electrically-conductive plate conforms to a shape of the top portion of the insulative member.

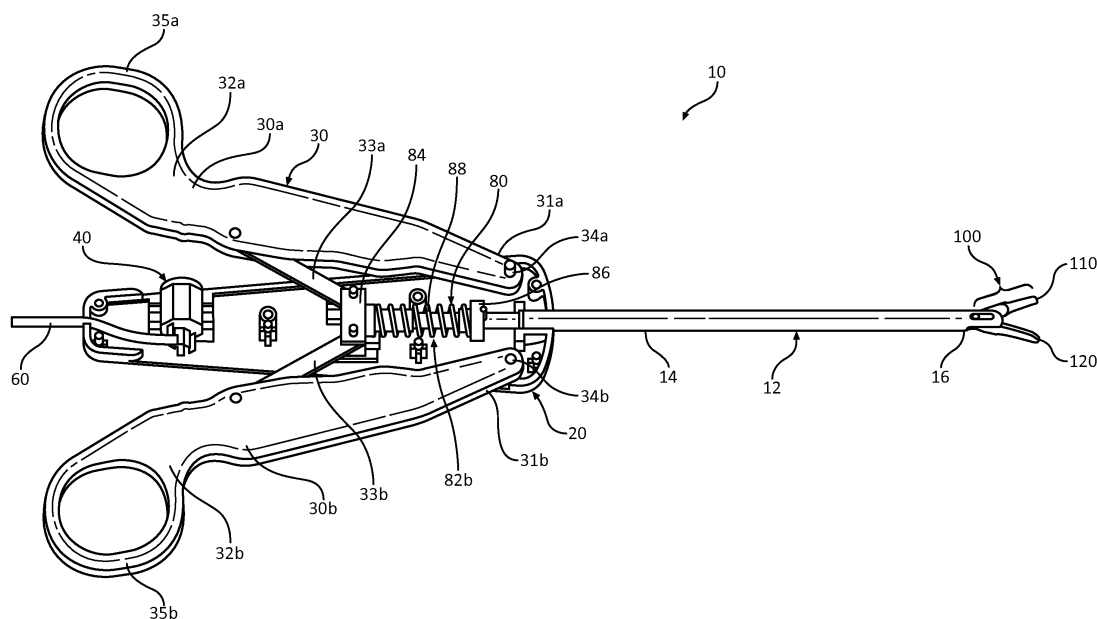


FIG. 1

Description

BACKGROUND

Technical Field

[0001] The present disclosure relates to surgical instruments and, more particularly, to a surgical forceps configured for treating and/or cutting tissue.

Background of Related Art

[0002] A surgical forceps is a plier-like device which relies on mechanical action between its jaws to grasp, clamp, and constrict tissue. Energy-based surgical forceps utilize both mechanical clamping action and energy to affect hemostasis by heating tissue to treat, e.g., coagulate, cauterize, and/or seal, tissue. However, as a by-product of treating a target area of tissue, thermal spread may result in inadvertent treating of tissue outside of the target area. It is therefore advantageous to treat tissue in as small a target area as possible, without compromising the effectiveness of the treatment, and to inhibit heating of tissue outside of the target area. Additionally, retained jaw heat can be sufficient to damage tissue if the jaw is allowed to touch unintended tissue before it sufficiently cools down. This retained heat can make it necessary for the surgeon to pause to allow the jaws to cool before continuing with additional treatments to other target tissue. Accordingly, a need exists for a device with both a very narrow sealing zone and very low thermal mass to minimize these issues without compromising functionality.

SUMMARY

[0003] As used herein, the term "distal" refers to the portion that is being described which is closer to a patient, while the term "proximal" refers to the portion that is being described which is further from a patient. Further, to the extent consistent, any of the aspects described herein may be used in conjunction with any or all of the other aspects described herein.

[0004] In accordance with the present disclosure, a surgical forceps including an end effector assembly is provided. The end effector assembly includes first and second jaw members. At least one of the first or second jaw members is movable relative to the other between a first position and a second position. At least one of the first or second jaw members has a jaw frame defining a channel therein, an insulative member disposed within the channel of the jaw frame, and an electrically-conductive plate having a tissue contacting surface and at least one folded side portion. The insulative member includes a top portion having a tissue facing surface. The tissue contacting surface of the electrically-conductive plate is disposed on the tissue facing surface of the insulative member. The at least one folded side portion of the elec-

trically-conductive plate is folded over the top portion of the insulative member such that the electrically-conductive plate conforms to a shape of the top portion of the insulative member.

[0005] In aspects, the insulative member further includes a base portion and a body portion extending between the top portion and the base portion, wherein at least one longitudinal groove is formed between the top portion and the base portion.

[0006] In aspects, the at least one folded side portion of the electrically-conductive plate includes a bottom edge disposed within the at least one longitudinal groove of the insulative member.

[0007] In aspects, the end effector assembly further includes an outer insulative housing formed about the jaw frame and having an opening extending there-through, wherein at least a portion of the tissue contacting surface of the electrically-conductive plate is accessible through the opening of the outer insulative housing.

[0008] In aspects, the outer insulative housing defines a tissue contacting surface, the tissue contacting surface of the outer insulative housing being raised above the tissue contacting surface of the electrically-conductive plate.

[0009] In aspects, the top portion of the insulative member defines a first width and the base portion of the insulative member defines a second width greater than the first width.

[0010] In aspects, the tissue contacting surface of the electrically-conductive plate defines a fourth width which is between about 0.020 inches and about 0.080 inches.

[0011] In aspects, the electrically-conductive plate defines a thickness of about 0.001 inches to about 0.004 inches.

[0012] In accordance with another aspect of the present disclosure, a surgical forceps including an end effector assembly is provided. The end effector assembly includes first and second jaw members. At least one of the first or second jaw members is movable relative to the other between a first position and second position.

At least one of the first or second jaw members has a jaw frame defining a channel therein, an insulative member disposed within the channel of the jaw frame, an electrically-conductive plate having a tissue contacting surface and at least one folded side portion, and an outer insulative housing enclosing the jaw frame. The insulative member includes a top portion, a base portion coupled to the top portion, and at least one longitudinal groove defined therebetween. The electrically-conductive plate is disposed on the top portion of the insulative member and folded about the insulative member such that the at least one folded side portion is folded into the at least one longitudinal groove. The outer insulative housing includes a tissue contacting surface defining an opening. At least a portion of the electrically-conductive plate is accessible through the opening of the outer insulative housing to treat tissue.

[0013] In aspects, the tissue contacting surface of the

electrically-conductive plate is recessed relative to the tissue contacting surface of the outer insulative housing.

[0014] In aspects, the tissue contacting surface of the electrically-conductive plate includes a first area and the tissue contacting surface of the outer insulative housing includes a second area, the first and second areas within an order of magnitude relative to one another.

[0015] In aspects, the at least one folded side portion of the electrically-conductive plate includes a bottom edge, wherein the bottom edge is folded within the at least one longitudinal groove of the insulative member.

[0016] In aspects, the insulative member further includes a body portion extending between the top portion and the base portion, wherein the body portion defines a third width less than the first width of the top portion and the second width of the base portion, such that the at least one longitudinal groove is formed between the top portion and the base portion.

[0017] In accordance with another aspect of the present disclosure, a surgical forceps including a housing, a shaft, an end effector assembly, and a drive assembly is provided. The shaft is supported by the housing and includes a distal end portion and a proximal end portion. The end effector assembly includes first and second jaw members. At least one of the first or second jaw members is movable relative to the other between a first position and a second position. At least one of the first or second jaw members has a jaw frame defining a channel therein, an insulative member disposed within the channel of the jaw frame, and an electrically-conductive plate having a tissue contacting surface and at least one folded side portion. The insulative member includes a top portion having a tissue facing surface. The tissue contacting surface of the electrically-conductive plate is disposed on the tissue facing surface of the insulative member. The at least one folded side portion of the electrically-conductive plate is folded over the top portion of the insulative member such that the electrically-conductive plate conforms to a shape of the top portion of the insulative member. The drive assembly is disposed within the housing and is configured to impart movement of the at least one of the first or second jaw members between the first and second positions.

BRIEF DESCRIPTION OF THE DRAWINGS

[0018] Various aspects and features of the present disclosure are described herein with reference to the drawings wherein:

FIG. 1 is a top view of a surgical forceps provided in accordance with the present disclosure, wherein a portion of the housing is removed and the end effector assembly is shown in an open configuration; FIG. 2A is a side, perspective view of the distal portion of the surgical forceps of FIG. 1, wherein the end effector assembly is shown in the open configuration; FIG. 2B is a side view of the distal portion of the

surgical forceps of FIG. 1, shown with parts separated;

FIG. 3A is a side, perspective view of one of the jaw members of the end effector assembly of the surgical forceps of FIG. 1;

FIG. 3B is a side, perspective view of the area of detail in FIG. 3A referenced as "3B";

FIG. 4A is a side, perspective view of the jaw member of FIG. 3A, with the outer insulative housing removed;

FIG. 4B is a front, perspective view of the electrically-conductive plate and insulative member of the jaw member of FIG. 3A; and

FIG. 5 is a front, perspective view of the area of detail in FIG. 4B referenced as "5," with the insulative member removed.

DETAILED DESCRIPTION

[0019] The present disclosure is directed to a surgical forceps including an end effector having jaws that are configured to minimize the heat affected zone surrounding a target tissue. In embodiments, the heat affected zone may be minimized by reducing the thermal mass of a conductive element, such as, for example, an electrically conductive seal plate of the jaws by reducing the overall width and thickness thereof. It is contemplated that the smaller footprint of the electrically conductive seal plate disclosed herein may yield faster heating and cooling of the electrically conductive seal plate, thereby resulting in an overall reduction in treatment cycle time.

[0020] With reference to FIG. 1, a surgical forceps configured for use in accordance with the present disclosure is shown generally identified by reference numeral 10. Forceps 10 is configured for use in various surgical procedures and generally includes a housing 20, a handle assembly 30, an activation assembly 40, and an end effector assembly 100 which mutually cooperate to grasp and treat tissue. Forceps 10 further includes a shaft 12 having a proximal end portion 14 that mechanically engages housing 20 and a distal end portion 16 that mechanically engages end effector assembly 100. A cable 60 is adapted to connect forceps 10 to a source of energy, e.g., a generator (not shown), although forceps 10 may alternatively be configured as a battery powered instrument.

[0021] Handle assembly 30 includes two movable handles 30a and 30b disposed on opposite sides of housing 20. Handles 30a and 30b are movable relative to one another to actuate end effector assembly 100, as will be described in greater detail below.

[0022] Continuing with reference to FIG. 1, end effector assembly 100 is attached at distal end portion 16 of shaft 12 and includes opposing first and second jaw members 110, 120. Handles 30a and 30b of handle assembly 30 ultimately connect to a drive assembly 80 disposed within housing 20 and extending through shaft 12 which, together, cooperate to impart movement of jaw members

110 and 120 from an open position wherein jaw members 110 and 120 are disposed in spaced relation relative to one another, to a closed position wherein jaw members 110 and 120 cooperate to grasp tissue therebetween, in response to movement of handles 30a, 30b from an un-actuated position, wherein handles 30a, 30b are spaced-apart from housing 20, and an actuated position, wherein handles 30a, 30b are approximated relative to housing 20.

[0023] With particular reference to FIGS. 2A and 2B, in conjunction with FIG. 1, first and second jaw members 110, 120 each include a proximal flange 113, 123. Proximal flanges 113, 123 of jaw members 110, 120 are pivotably coupled to one another and shaft 12 via a pivot pin 103. Specifically, pivot pin 103 extends through respective pivot apertures 112a, 122a of proximal flanges 113, 123 and a pivot aperture 12a of shaft 12 to pivotably couple jaw members 110, 120 to one another and shaft 12. End effector assembly 100 is designed as a bilateral assembly, e.g., where both jaw member 110 and jaw member 120 are moveable about pivot 103 relative to one another and to shaft 12. However, end effector assembly 100 may alternatively be configured as a unilateral assembly, e.g., where one of the jaw members 110, 120 is fixed relative to shaft 12 and the other jaw member 110, 120 is moveable about pivot 103 relative to shaft 12 and the fixed jaw member 110, 120.

[0024] Proximal flanges 113, 123 of jaw members 110, 120, respectively, each further include an oppositely-angled cam slot 112b, 122b defined therethrough that is configured to receive a drive pin 105. Drive pin 105 also extends through an aperture 83 at a distal end portion 82a of a drive bar 82 of drive assembly 80, such that, as will be described in greater detail below, reciprocation of drive bar 82 through shaft 12 effects pivoting of jaw members 110, 120 relative to one another between the open and closed positions. A longitudinally-extending slot 12b defined through shaft 12 on either side thereof is configured to receive the ends of drive bar 105 to confine drive pin 105 to longitudinal translation therethrough.

[0025] Drive assembly 80, as noted above, includes drive bar 82. Drive assembly 80 also includes a drive block 84 disposed within housing 20 and slidably disposed about a proximal end portion 82b of drive bar 82, a drive collar 86 engaged about proximal end portion 82b of drive bar 82, and a spring 88 disposed about proximal end portion 82b of drive bar 82 and positioned between drive block 84 and drive collar 86. Drive block 84 is coupled to handles 30a, 30b via link arms 33a, 33b, respectively. Handles 30a and 30b are pivotably coupled to housing 20 at their respective distal end portions 31a, 31b via pivot pins 34a, 34b, respectively, and extend proximally to proximal end portions 32a, 32b, respectively, thereof. Finger rings 35a, 35b are defined at the respective proximal end portions 32a, 32b of handles 30a, 30b.

[0026] Handles 30a, 30b are coupled to drive block 84 such that pivoting of handles 30a, 30b about pivot pins

34a, 34b, respectively, from the un-actuated position to the actuated position translates drive block 84 distally through housing 20. Initially, this distal translation of drive block 84 urges spring 88 distally to, in turn, urge drive collar 86 distally. Since drive collar 86 is engaged about drive bar 82, distal urging of drive collar 86 translates drive bar 82 distally through shaft 12 to effect pivoting of jaw members 110, 120 from the open position towards the closed position. When sufficient force inhibiting further approximation of jaw members 110, 120, e.g., the force of tissue grasped therebetween resisting further compression, is imparted to drive bar 82, further pivoting of handles 30a, 30b translates drive block 84 distally through housing 20 to compress spring 88 such that drive collar 86 and drive bar 82 are maintained in position. In this manner, drive assembly 80 defines a force-regulating configuration. In some embodiments, drive assembly 80 may be configured to regulate the pressure applied to tissue grasped between jaw members 110, 120 to within a range of about 3 kg/cm² to about 16 kg/cm², although other pressures or pressure ranges are also contemplated.

[0027] Jaw members 110, 120 may be moved back to the open position by releasing or returning handles 30a, 30b to the spaced-apart position relative to one another and housing 20 such that drive block 84, spring 88, and drive collar 86 moves proximally. As drive collar 86 is moved proximally, drive bar 82 is pulled through shaft 12 in the proximal direction such that drive pin 105 urges jaw members 110, 120 to pivot away from one another to the open position (see FIG. 2A).

[0028] Turning now to FIGS. 3A and 3B, jaw member 110 of end effector assembly 100 is described in greater detail. Although only jaw member 110 is shown and described hereinbelow, it is understood that jaw member 120 defines a similar configuration.

[0029] Jaw member 110 includes proximal flange 113 and a jaw frame 115 extending distally from proximal flange 113. Jaw frame 115 includes a channel 115a (FIG. 4A) configured to receive an electrically-conductive plate 116 disposed over an insulative member 117 (FIG. 4A). Electrically-conductive plate 116 is electrically coupled to activation assembly 40 and the source of energy (not shown), e.g., via wire 118, which extends from jaw member 110 through shaft 12, such that energy may be selectively supplied to electrically-conductive plate 116 and conducted through tissue grasped between jaw members 110, 120 to treat tissue. The electrically-conductive plate 116, insulative member 117, and distal portion of wire 118 are encapsulated and retained in position within jaw frame 115 by an outer insulative housing 119. Outer insulative housing 119 is overmolded onto jaw frame 115, although other manufacturing processes are also contemplated. More specifically, outer insulative housing 119 surrounds jaw frame 115 and fills the portion of channel 115a not occupied by electrically-conductive plate 116 and insulative member 117.

[0030] With specific reference to FIG. 3B, outer insu-

lative housing 119 includes a tissue contacting surface 119a and an opening 119b formed therein, within which electrically-conductive plate 116 is recessed. Opening 119b extends longitudinally through tissue contacting surface 119a and provides access to electrically-conductive plate 116 when outer insulative housing 119 is formed on, e.g., overmolded onto, jaw frame 115.

[0031] A portion of electrically-conductive plate 116 is exposed within opening 119b such that tissue contacting surface 119a of outer insulative housing 119 is raised above a tissue contacting surface 116a of electrically-conductive plate 116 a distance "D". The raised tissue contacting surface 119a of outer insulative housing 119 relative to electrically-conductive plate 116 provides a gap between electrically-conductive plate 116 of jaw member 110 and the electrically-conductive plate of jaw member 120 (not shown; which may similarly be recessed relative to an outer insulative housing of jaw member 120), thereby establishing an appropriate gap distance between the electrically-conductive plates when jaw members 110, 120 to facilitate treating tissue grasped therebetween when jaw members 110, 120 are in the closed position. End effector assembly 100 may be configured such that the gap distance (equal to twice the distance "D", where both electrically-conductive surfaces are recessed, or equal to distance "D" when only electrically-conductive surface 116a of jaw member 110 is recessed) is within a range of about 0.001 inches to about 0.006 inches, although other gap distances or gap distance ranges are also contemplated.

[0032] As shown in FIGS. 3A and 3B, an area "A1" of the raised tissue contacting surface 119a of outer insulative housing 119, which serves as the gap-setting structure of end effector assembly 100, is within an order of magnitude of, or greater than, an area "A2" of the tissue contacting surface 116a of electrically-conductive plate 116. This relatively-large area "A1" greatly reduces the stresses placed on tissue contacting surface 119a of outer insulative housing 119 at any one point when jaw members 110, 120 are closed, thereby reducing the wear and tear of tissue contacting surface 119a. As such, the need to form outer insulative housing 119 out of more-robust, thicker, or reinforced materials is obviated, thus reducing manufacturing costs associated with outer insulative housing 119.

[0033] With reference to FIGS. 4A and 4B, electrically-conductive plate 116 is shown disposed on insulative member 117 with outer insulative housing 119 removed (see FIG. 4A) and with jaw frame 115 removed (see FIG. 4B).

[0034] Insulative member 117 includes a substantially "I-shaped" cross-section and extends substantially along a length of channel 115a of jaw frame 115. Insulative member 117 includes a top portion 117a and a base portion 117b, where top portion 117a has a width "W1" smaller than a width "W2" of base portion 117b. Insulative member 117 also includes a body portion 117c extending between top portion 117a and base portion 117b. Body

portion 117c includes a width "W3" that is less than width "W1" of top portion 117a and less than width "W2" of base portion 117b, thus defining the "I-shaped" cross-section of insulative member 117. Body portion 117c extends along the length of insulative member 117 and spaces apart top portion 117a and base portion 117b. Since width "W3" of body portion 117c is less than both, width "W1" of top portion 117a and width "W2" of base portion 117b, a pair of longitudinal grooves 126a, 126b are defined between top portion 117a and base portion 117b on opposite sides of body portion 117c.

[0035] Electrically-conductive plate 116 includes tissue contacting surface 116a disposed on a top, e.g., tissue facing surface 127a, of top portion 117a of insulative member 117 and a plurality of side portions 116b. Electrically-conductive plate 116 may be manufactured through a metal working method, such as, for example, progressive stamping. Once the flat material for electrically-conductive plate 116 is punched out, the plurality of side portions 116b are folded over a plurality of sides 127b of top portion 117a of insulative member 117, on at least three sides thereof, to correspond to the configuration of top portion 117a of insulative member 117. In embodiments, a bottom edge 116c of each of the plurality of side portions 116b may be further folded or crimped into longitudinal grooves 126a, 126b to secure electrically-conductive plate 116 onto top portion 117a of insulative member 117. In alternative embodiments, the plurality of side portions 116b of electrically-conductive plate 116 may be pressed or pierced into the plurality of sides 127b of insulative member 117. As an alternative to folding a flat piece of material to define the folds of electrically-conductive plate 116, electrically-conductive plate 116 may be formed to include the folds, such as by drawing. Thus, the term "fold" or "folded" as utilized herein is not limited to a flat (or otherwise formed) piece of material that has been folded, but also includes a material formed to include the fold(s) during formation thereof.

[0036] With additional reference to FIG. 5, electrically-conductive plate 116 is shown with insulative member 117 removed. In accordance with the present disclosure, electrically-conductive plate 116 is configured to include a reduced thermal mass "TM" to facilitate the cool down process of electrically-conductive plate 116 after supplying energy to tissue as well as the heating of electrically-conductive plate 116 upon supplying energy thereto. As can be appreciated, a low thermal mass "TM" of electrically-conductive plate 116 may also be beneficial to prevent unintended thermal spread of heat to surrounding tissue from heat retained within jaw members 110, 120 during and after treating target tissue.

[0037] The reduction in thermal mass "TM" of electrically-conductive plate 116 is accomplished by reducing a thickness "T" and a width "W4" of electrically-conductive plate 116 by an order of magnitude as compared to typical electrosurgical forceps. For example, electrically-conductive plate 116 may include width "W4" of about 0.020 inches to about 0.080 inches. Further, electrically-

conductive plate 116 may include thickness "T" of about 0.001 inches to about 0.004 inches. It is contemplated that further reductions in thermal mass "TM" of electrically-conductive plate 116 may be achieved by reducing the overall length of jaw members 110, 120, and in turn electrically-conductive plate 116. Since the volume of materials used in electrically-conductive plate 116 is reduced, typically cost-prohibitive materials with higher thermal conductivity, such as, for example, gold, silver, brass, copper, and the like, may be economically used in the construction of jaw member 110.

[0038] Although not shown in the figures, the various embodiments disclosed herein may also be configured to work with robotic surgical systems and what is commonly referred to as "Telesurgery." Such systems employ various robotic elements to assist the surgeon and allow remote operation (or partial remote operation) of surgical instrumentation. Various robotic arms, gears, cams, pulleys, electric and mechanical motors, etc. may be employed for this purpose and may be designed with a robotic surgical system to assist the surgeon during the course of an operation or treatment. Such robotic systems may include remotely steerable systems, automatically flexible surgical systems, remotely flexible surgical systems, remotely articulating surgical systems, wireless surgical systems, modular or selectively configurable remotely operated surgical systems, etc.

[0039] The robotic surgical systems may be employed with one or more consoles that are next to the operating theater or located in a remote location. In this instance, one team of surgeons or nurses may prep the patient for surgery and configure the robotic surgical system with one or more of the instruments disclosed herein while another surgeon (or group of surgeons) may remotely control the instruments via the robotic surgical system. As can be appreciated, a highly skilled surgeon may perform multiple operations in multiple locations without leaving his/her remote console which can be both economically advantageous and a benefit to the patient or a series of patients.

[0040] The robotic arms of the surgical system are typically coupled to a pair of master handles by a controller. The handles can be moved by the surgeon to produce a corresponding movement of the working ends of any type of surgical instrument (e.g., end effectors, graspers, knives, scissors, etc.) which may complement the use of one or more of the embodiments described herein. The movement of the master handles may be scaled so that the working ends have a corresponding movement that is different, smaller or larger, than the movement performed by the operating hands of the surgeon. The scale factor or gearing ratio may be adjustable so that the operator can control the resolution of the working ends of the surgical instrument(s).

[0041] The master handles may include various sensors to provide feedback to the surgeon relating to various tissue parameters or conditions, e.g., tissue resistance due to manipulation, cutting or otherwise treating,

pressure by the instrument onto the tissue, tissue temperature, tissue impedance, etc. As can be appreciated, such sensors provide the surgeon with enhanced tactile feedback simulating actual operating conditions. The master handles may also include a variety of different actuators for delicate tissue manipulation or treatment further enhancing the surgeon's ability to mimic actual operating conditions.

[0042] From the foregoing and with reference to the various figure drawings, those skilled in the art will appreciate that certain modifications can also be made to the present disclosure without departing from the scope of the same. While several embodiments of the disclosure have been shown in the drawings, it is not intended that the disclosure be limited thereto, as it is intended that the disclosure be as broad in scope as the art will allow and that the specification be read likewise. For example, in embodiments, it is contemplated that electrically-conductive plate 116 may be a printed circuit board. Further, in some embodiments, electrically-conductive plate 116 may be electro-plated or electrolessly plated onto insulative member 117. In other embodiments, it is contemplated that vapor deposition may be used to deposit electrically-conductive plate 116 onto insulative member 117. Regardless of the particular materials and/or formation, the electrically-conductive plate 116 is otherwise similar to and may include any of the features detailed hereinabove. Therefore, the above description should not be construed as limiting, but merely as exemplifications of particular embodiments. Those skilled in the art will envision other modifications within the scope and spirit of the claims appended hereto.

[0043] The invention may be described by reference to the following numbered paragraphs:-

1. A surgical forceps, comprising:
an end effector assembly including:
first and second jaw members, at least one of the first or second jaw members movable relative to the other between first and second positions, at least one of the first or second jaw members including:

a jaw frame defining a channel therein;
an insulative member disposed within the channel of the jaw frame, the insulative member including a top portion having a tissue facing surface; and
an electrically-conductive plate having a tissue contacting surface and at least one folded side portion, wherein the tissue contacting surface is disposed on the tissue facing surface of the insulative member and wherein the at least one folded side portion is folded over the top portion of the insulative member such that the electrically-conductive plate conforms to a shape of the top portion of the insulative member.

2. The surgical forceps according to paragraph 1,

wherein the insulative member further includes a base portion and a body portion extending between the top portion and the base portion, wherein at least one longitudinal groove is defined between the top portion and the base portion.

3. The surgical forceps according to paragraph 2, wherein the at least one folded side portion of the electrically-conductive plate includes a bottom edge disposed within the at least one longitudinal groove of the insulative member.

4. The surgical forceps according to paragraph 1, further comprising:

an outer insulative housing formed about the jaw frame and including an opening extending there-through, wherein at least a portion of the tissue contacting surface of the electrically-conductive plate is accessible through the opening of the outer insulative housing.

5. The surgical forceps according to paragraph 4, wherein the outer insulative housing defines a tissue contacting surface, the tissue contacting surface of the outer insulative housing being raised above the tissue contacting surface of the electrically-conductive plate.

6. The surgical forceps according to paragraph 1, wherein the top portion of the insulative member defines a first width and the base portion of the insulative member defines a second width greater than the first width.

7. The surgical forceps according to paragraph 6, wherein the tissue contacting surface of the electrically-conductive plate defines a fourth width which is between about 0.020 inches and about 0.080 inches .

8. The surgical forceps according to paragraph 1, wherein the electrically-conductive plate defines a thickness of about 0.001 inches to about 0.004 inches.

9. A surgical forceps, comprising:

an end effector assembly including:

first and second jaw members, at least one of the first or second jaw members movable relative to the other between first and second positions, at least one of the first or second jaw members including:

a jaw frame defining a channel therein;

an insulative member disposed within the channel of the jaw frame, the insulative member having a top portion, a base portion coupled to the top portion, and at least one longitudinal groove defined therebetween;

an electrically-conductive plate having a tissue contacting surface and at least one folded side portion, the electrically-conductive plate disposed on the top portion of the insulative member and folded about the insulative member such that the at least one folded side portion is folded into the at least one longitudinal groove; and an outer insulative housing enclosing the jaw frame, the outer insulative housing including a tissue contacting surface defining an opening, wherein at least a portion of the electrically-conductive plate is accessible through the opening of the outer insulative housing to treat tissue.

10. The surgical forceps according to paragraph 9, wherein the tissue contacting surface of the electrically-conductive plate is recessed relative to the tissue contacting surface of the outer insulative housing.

11. The surgical forceps according to paragraph 9, wherein the tissue contacting surface of the electrically-conductive plate includes a first area and the tissue contacting surface of the outer insulative housing includes a second area, the first and second areas within an order of magnitude relative to one another.

12. The surgical forceps according to paragraph 9, wherein the top portion of the insulative member defines a first width and the base portion of the insulative member defines a second width greater than the first width.

13. The surgical forceps according to paragraph 9, wherein the tissue contacting surface of the electrically-conductive plate defines a fourth width which is between about 0.020 inches and about 0.080 inches.

14. The surgical forceps according to paragraph 9, wherein the electrically-conductive plate defines a thickness of about 0.001 inches to about 0.004 inches.

15. The surgical forceps according to paragraph 9, wherein the at least one folded side portion of the electrically-conductive plate includes a bottom edge, wherein the bottom edge is folded within the at least one longitudinal groove of the insulative member.

16. The surgical forceps according to paragraph 12, wherein the insulative member further includes a body portion extending between the top portion and the base portion, wherein the body portion defines a third width less than the first width of the top portion and the second width of the base portion, such that the at least one longitudinal groove is formed be-

tween the top portion and the base portion.

17. A surgical forceps, comprising:

- a housing; 5
- a shaft supported by the housing, the shaft having a distal end portion and a proximal end portion; 10
- an end effector assembly supported at the distal end portion of the shaft, the end effector assembly including: 15
 - first and second jaw members, at least one of the first or second jaw members movable relative to the other between first and second positions, at least one of the first or second jaw members including: 20
 - a jaw frame defining a channel therein;
 - an insulative member disposed within the channel of the jaw frame, the insulative member including a top portion having a tissue facing surface; and
 - an electrically-conductive plate having a tissue contacting surface and at least one folded side portion, wherein the tissue contacting surface is disposed on the tissue facing surface of the insulative member and wherein the at least one folded side portion is folded over the top portion of the insulative member such that the electrically-conductive plate conforms to a shape of the top portion of the insulative member; and 25
- a drive assembly disposed within the housing, the drive assembly configured to impart movement of the at least one of the first or second jaw members between the first and second positions. 30

Claims

1. A surgical forceps, comprising:
 - an end effector assembly including: 45
 - first and second jaw members, at least one of the first or second jaw members movable relative to the other between first and second positions, at least one of the first or second jaw members including: 50
 - a jaw frame defining a channel therein;
 - an insulative member disposed within the channel of the jaw frame, the insulative member including a top portion having a tissue facing surface; and
 - an electrically-conductive plate having a tissue contacting surface and at least one folded side portion, wherein the tissue contacting surface is disposed on the tissue facing surface of the in-

ulative member and wherein the at least one folded side portion is folded over the top portion of the insulative member such that the electrically-conductive plate conforms to a shape of the top portion of the insulative member.

2. The surgical forceps according to claim 1, wherein the insulative member further includes a base portion and a body portion extending between the top portion and the base portion, wherein at least one longitudinal groove is defined between the top portion and the base portion.
3. The surgical forceps according to claim 2, wherein the at least one folded side portion of the electrically-conductive plate includes a bottom edge disposed within the at least one longitudinal groove of the insulative member.
4. The surgical forceps according to any preceding claim, further comprising:
 - an outer insulative housing formed about the jaw frame and including an opening extending therethrough, wherein at least a portion of the tissue contacting surface of the electrically-conductive plate is accessible through the opening of the outer insulative housing, preferably wherein the outer insulative housing defines a tissue contacting surface, the tissue contacting surface of the outer insulative housing being raised above the tissue contacting surface of the electrically-conductive plate.
5. The surgical forceps according to any preceding claim, wherein the top portion of the insulative member defines a first width and the base portion of the insulative member defines a second width greater than the first width preferably wherein the tissue contacting surface of the electrically-conductive plate defines a fourth width which is between about 0.020 inches and about 0.080 inches .
6. The surgical forceps according to any preceding claim, wherein the electrically-conductive plate defines a thickness of about 0.001 inches to about 0.004 inches.
7. A surgical forceps, comprising:
 - an end effector assembly including:
 - first and second jaw members, at least one of the first or second jaw members movable relative to the other between first and second positions, at least one of the first or second jaw members including:
 - a jaw frame defining a channel therein;
 - an insulative member disposed within the channel of the jaw frame, the insulative member having a top portion, a base portion coupled to the top portion, and at least one longitudinal groove

defined therebetween;

an electrically-conductive plate having a tissue contacting surface and at least one folded side portion, the electrically-conductive plate disposed on the top portion of the insulative member and folded about the insulative member such that the at least one folded side portion is folded into the at least one longitudinal groove; and an outer insulative housing enclosing the jaw frame, the outer insulative housing including a tissue contacting surface defining an opening, wherein at least a portion of the electrically-conductive plate is accessible through the opening of the outer insulative housing to treat tissue.

8. The surgical forceps according to claim 7, wherein the tissue contacting surface of the electrically-conductive plate is recessed relative to the tissue contacting surface of the outer insulative housing.
9. The surgical forceps according to claim 7, wherein the tissue contacting surface of the electrically-conductive plate includes a first area and the tissue contacting surface of the outer insulative housing includes a second area, the first and second areas within an order of magnitude relative to one another.
10. The surgical forceps according to any one of claims 7 to 9, wherein the top portion of the insulative member defines a first width and the base portion of the insulative member defines a second width greater than the first width.
11. The surgical forceps according to any one of claims 7 to 10, wherein the tissue contacting surface of the electrically-conductive plate defines a fourth width which is between about 0.020 inches and about 0.080 inches.
12. The surgical forceps according to any one of claims 7 to 11, wherein the electrically-conductive plate defines a thickness of about 0.001 inches to about 0.004 inches.
13. The surgical forceps according to any one of claims 7 to 12, wherein the at least one folded side portion of the electrically-conductive plate includes a bottom edge, wherein the bottom edge is folded within the at least one longitudinal groove of the insulative member.
14. The surgical forceps according to claim 10, wherein the insulative member further includes a body portion extending between the top portion and the base portion, wherein the body portion defines a third width less than the first width of the top portion and the second width of the base portion, such that the at least one longitudinal groove is formed between the

top portion and the base portion.

15. A surgical forceps, comprising:

a housing;
a shaft supported by the housing, the shaft having a distal end portion and a proximal end portion;
an end effector assembly supported at the distal end portion of the shaft, the end effector assembly including:
first and second jaw members, at least one of the first or second jaw members movable relative to the other between first and second positions, at least one of the first or second jaw members including:

a jaw frame defining a channel therein;
an insulative member disposed within the channel of the jaw frame, the insulative member including a top portion having a tissue facing surface; and
an electrically-conductive plate having a tissue contacting surface and at least one folded side portion, wherein the tissue contacting surface is disposed on the tissue facing surface of the insulative member and wherein the at least one folded side portion is folded over the top portion of the insulative member such that the electrically-conductive plate conforms to a shape of the top portion of the insulative member; and

a drive assembly disposed within the housing, the drive assembly configured to impart movement of the at least one of the first or second jaw members between the first and second positions.

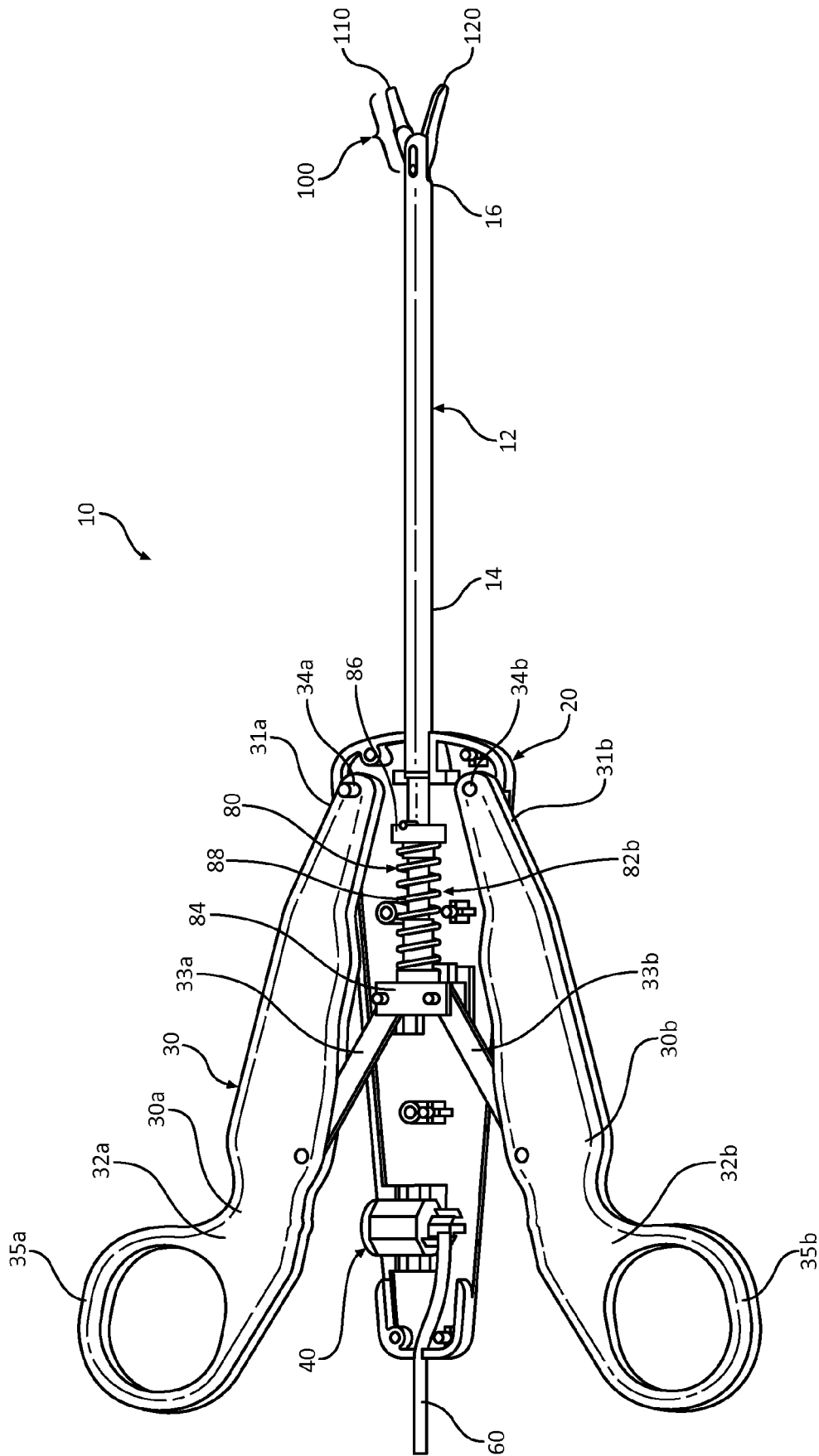


FIG. 1

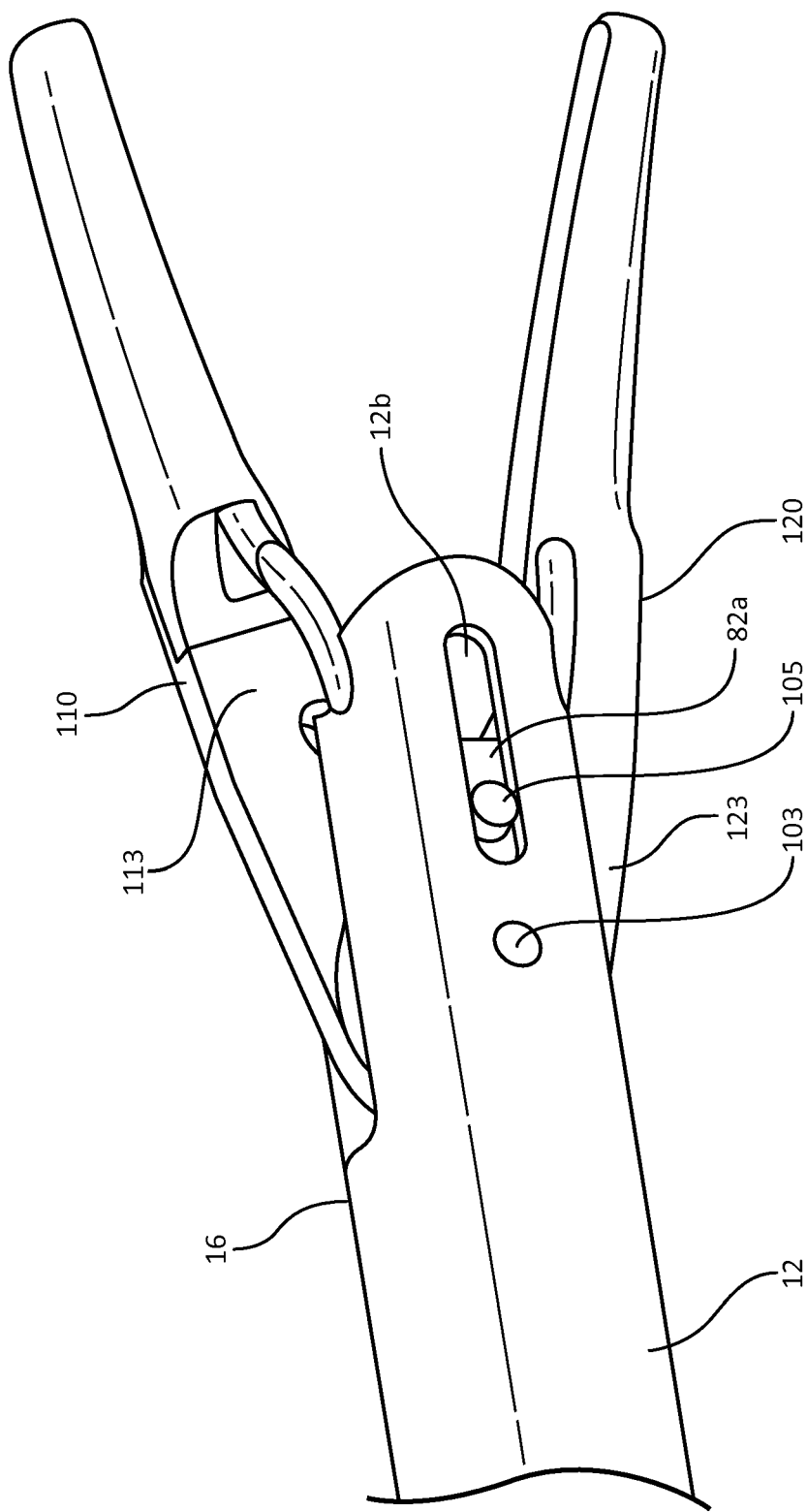


FIG. 2A

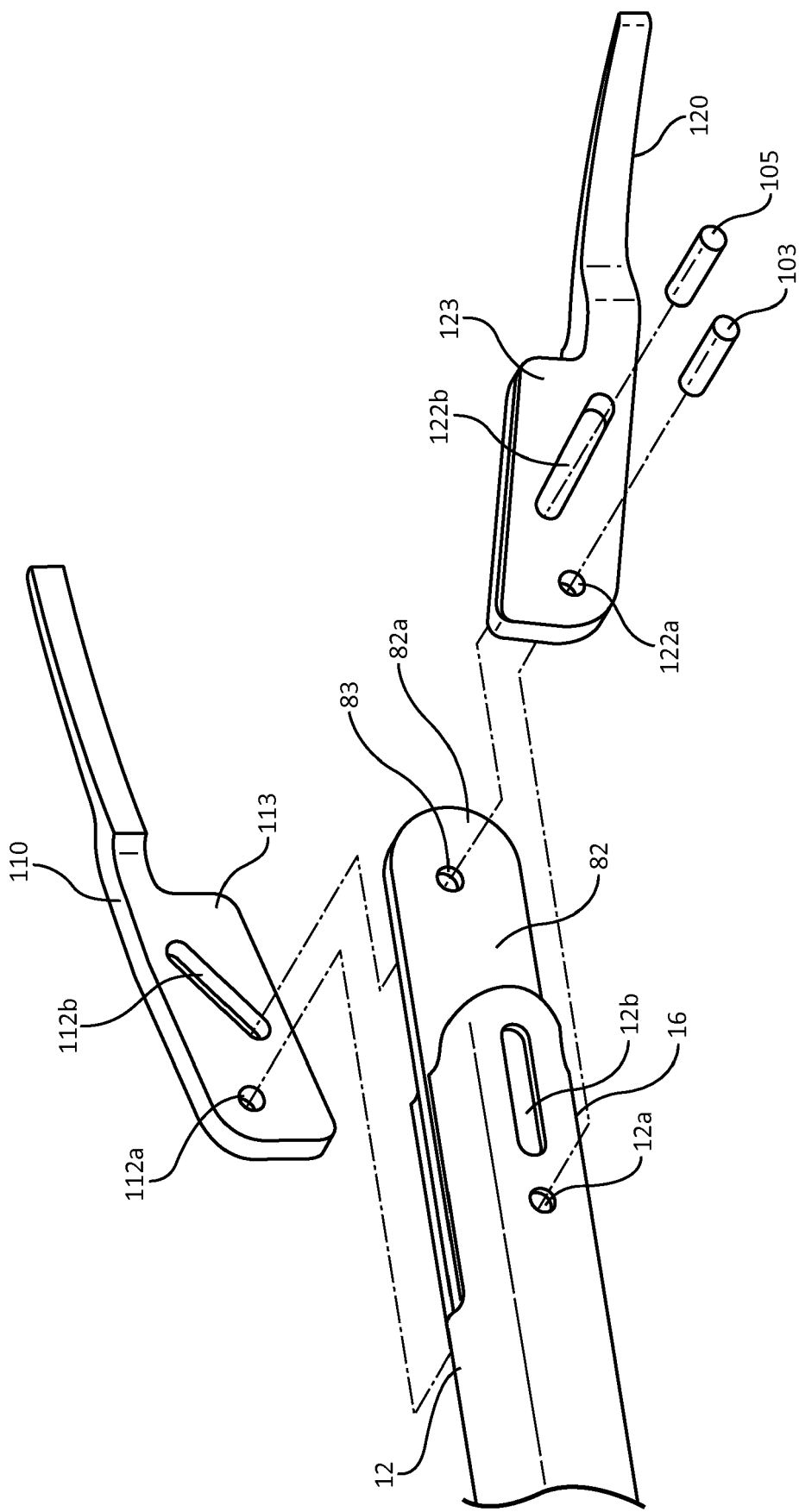


FIG. 2B

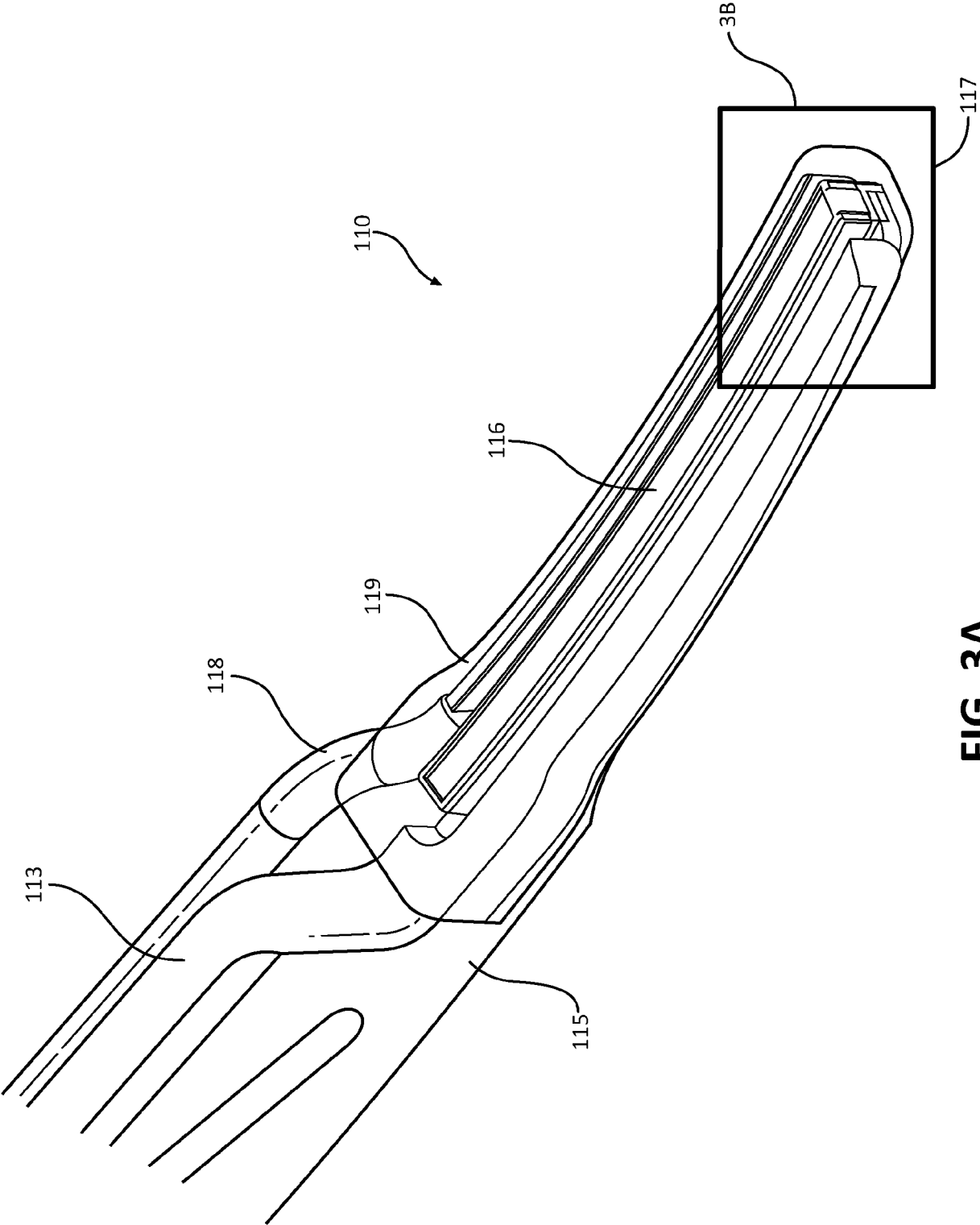


FIG. 3A

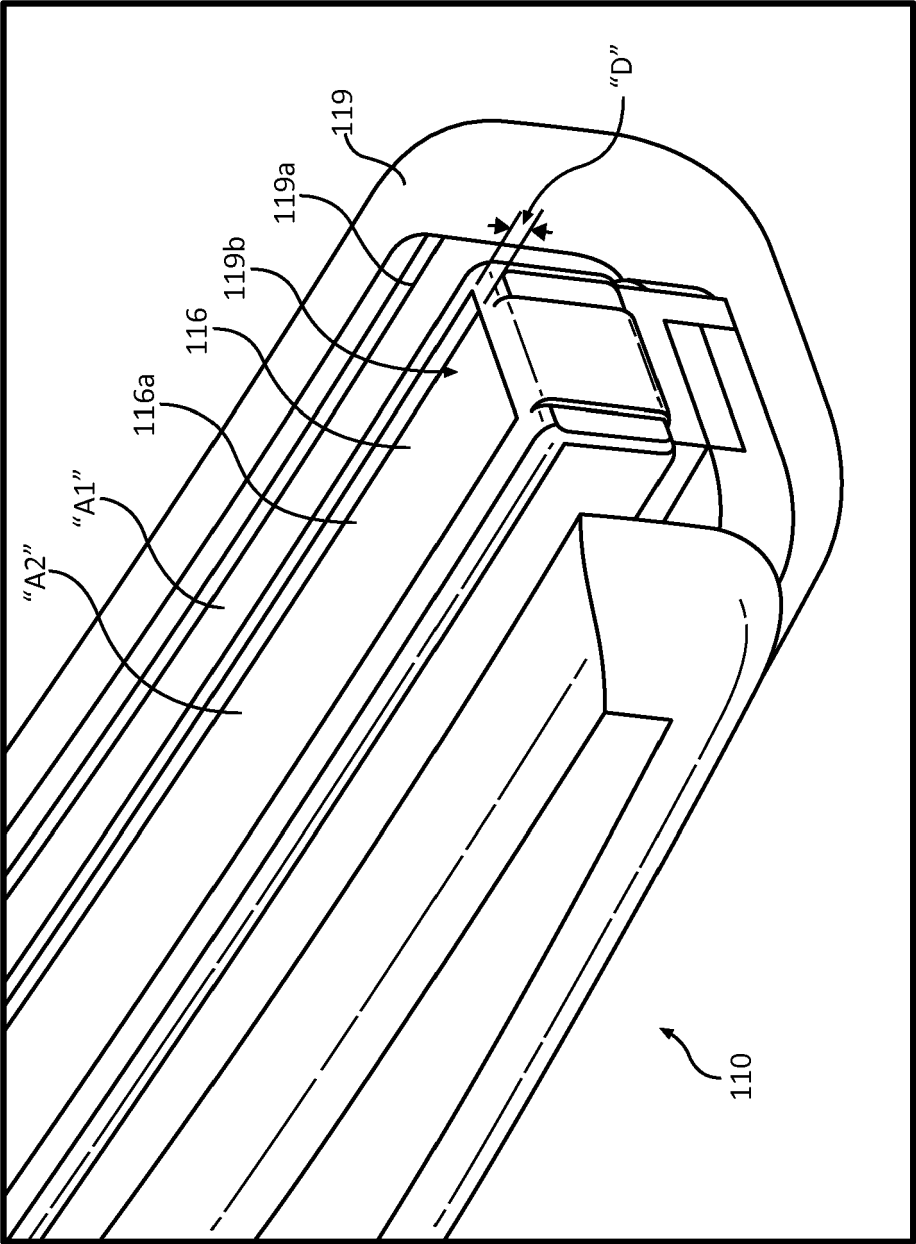


FIG. 3B

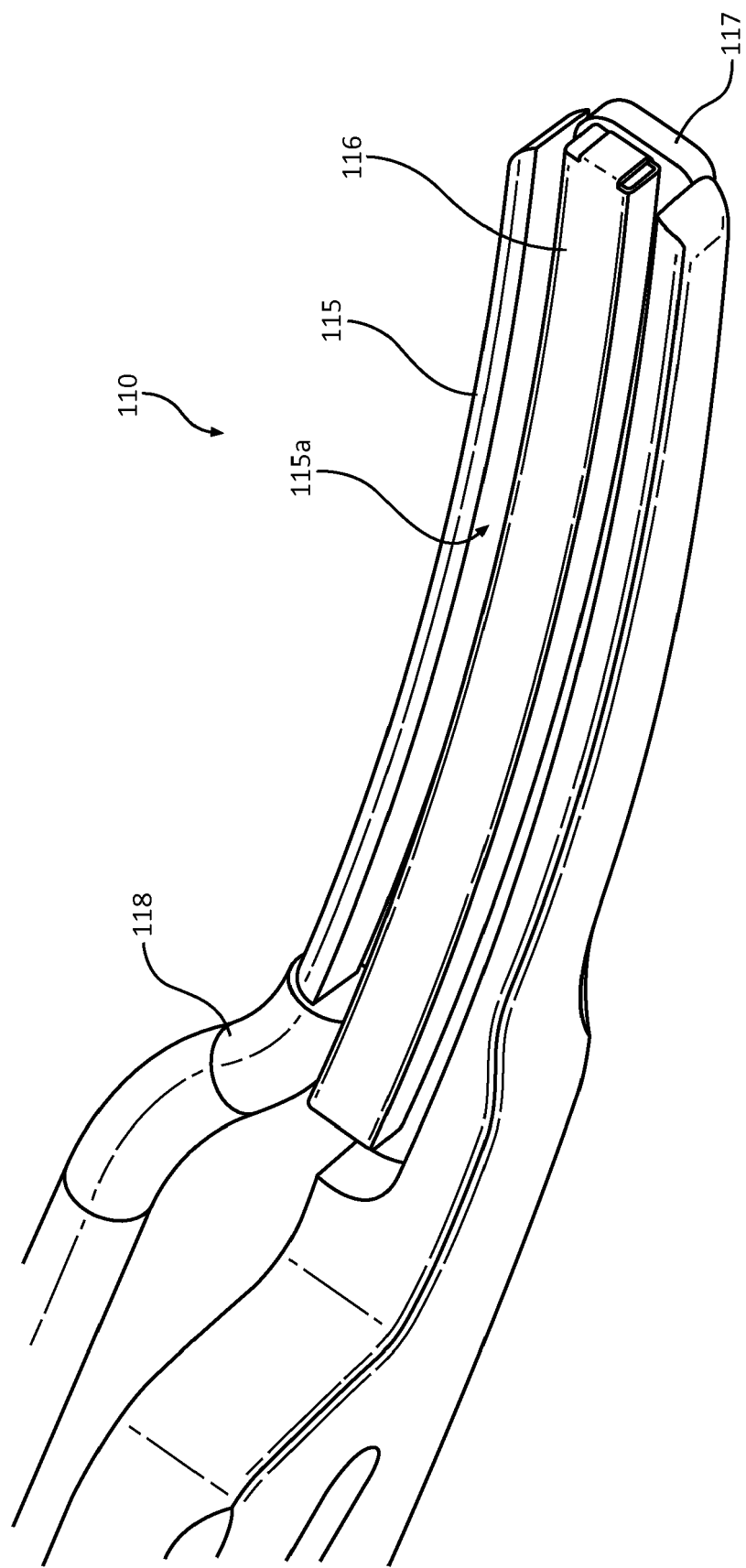


FIG. 4A

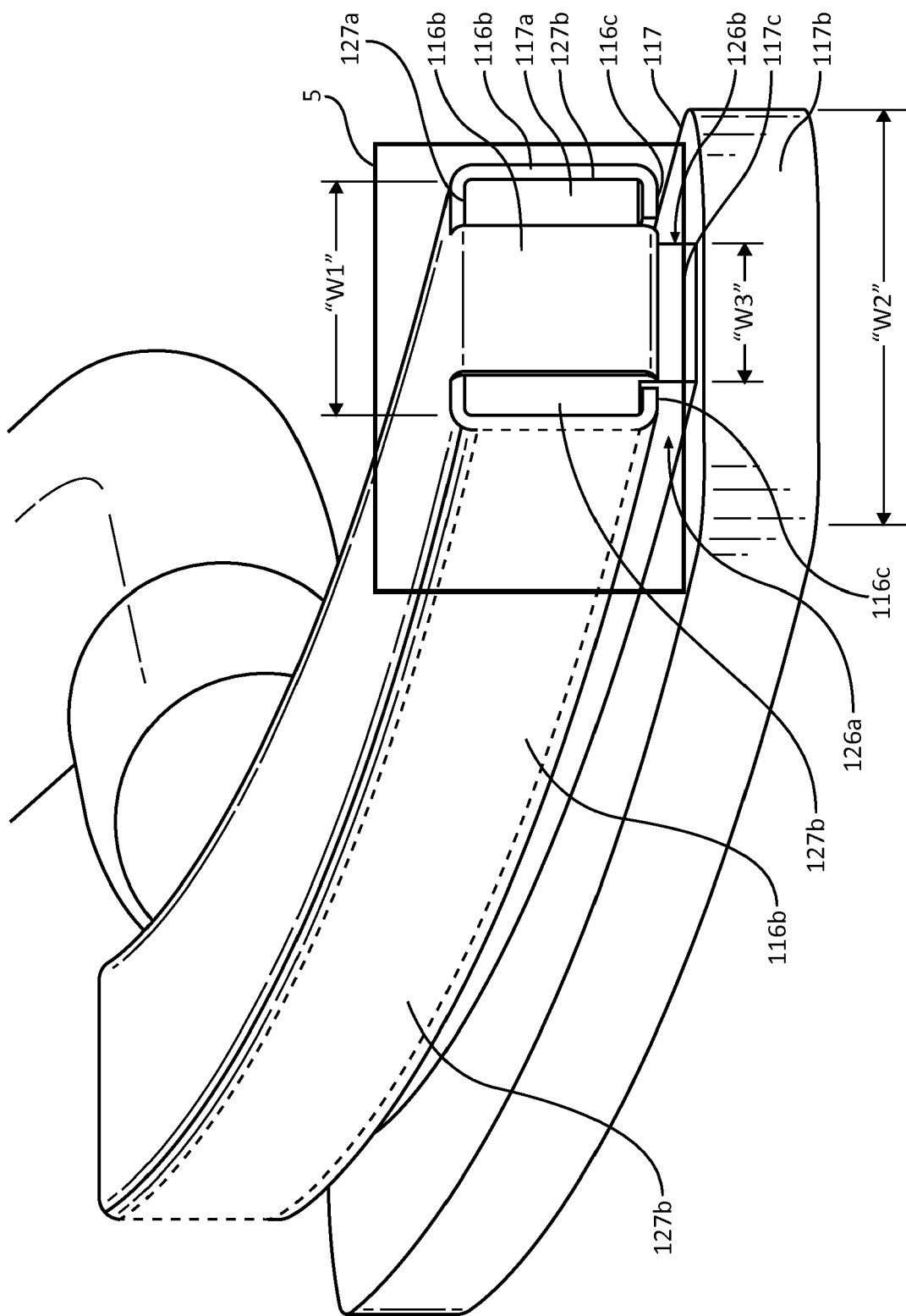


FIG. 4B

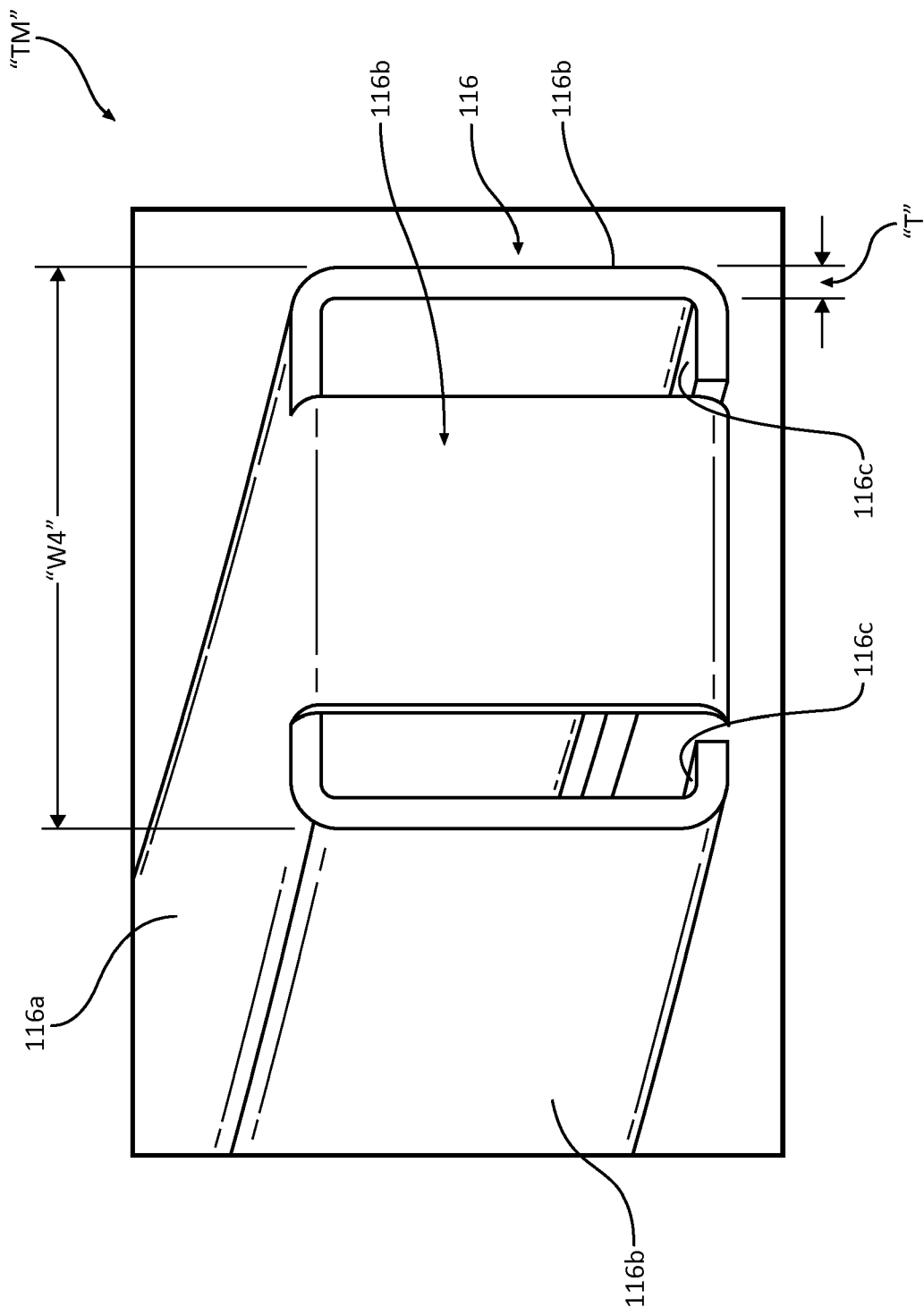


FIG. 5



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Place of search Munich		Date of completion of the search 11 July 2018	Examiner Lorenz, Larissa
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